**Unit 2 – Activity 1**

**Simulating Motion**

**Part I**

Today we will be taking the data you collected in lab and using them to produce a working simulation of the motion of the buggy. In order to do this, we must first describe the motion of your buggy as a ***function***.

There are a few ways we could set this function up, and we will explore two of them throughout this unit. Today, we want to write a function called next-x. The ***purpose statement*** of this function is as follows:

|  |
| --- |
| “Consumes the current position of the buggy and produces its position at the next metronome tick.” |

1. What does this function need to take as an input? What does this function produce as an output?
2. Write a ***contract*** for this function.
3. Use the data from your lab to fill in the following **examples** of this next-x function working properly.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 0 | → | next-x(0) | → |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 25 | → | next-x(25) | → |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | → | next-x( ) | → | 50 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | → | next-x( ) | → |  |

1. Write an algebraic expression which can be used to calculate the output of this function from its input .
2. Fill out a ***design recipe*** for this next-x function.

|  |
| --- |
| **Design Recipe** |

|  |
| --- |
| **Physical Interpretation** |

What will the input(s) of your function be?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(ex: length)

What will the units of each input be?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(ex: meters)

What will the output be?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(ex: density)

What will the unit of the output be?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(ex: grams/meter3)

|  |
| --- |
| **Contract & Purpose Statement** |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| # |  | :: |  | -> |  | |
|  | name |  | Domain (type of input(s)) |  | Range (type of output) | |
| # |  | | | | | |
|  | What does the function do? (The function consumes \_\_\_\_\_\_ and produces \_\_\_\_\_\_\_.) | | | | | |
| **Examples** | | | | | |

Write examples of your function in action

**examples:**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(\_\_\_\_\_\_\_\_\_\_\_\_\_\_)

name example input(s)

**is**  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What calculation must be performed?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(\_\_\_\_\_\_\_\_\_\_\_\_\_\_)

name example input(s)

**is**  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What calculation must be performed?

**end**

|  |
| --- |
| **Function Definition** |

Circle the changing quantities in your examples and name them (consider the names used for the physical quantities above).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **fun** |  | ( |  | ): |
|  |  | | | |
|  |
| **end** |  |  |  |  |

**Part II**

Load the program found at the following URL: <https://tinyurl.com/y6v7mmfc>. There are two things you need to fill in before this simulation will run, as noted by the … in the code.

The first is the identifier delta-t. As the comment indicates, this value represents how much time passed between each tick of the metronome. When we did this experiment as a class, the metronome was set to tick every two seconds, so for now set the value of delta-t to 2 (you will be able to play around with this later).

1. Use the design recipe you filled out in Part I to complete the next-x function in the code.
2. Once you’ve finished editing your program, run the simulation and describe what happens. Is this how you expected your simulation to work? Explain.
3. How far did the buggy go before the simulation ended? How many ticks did that take? How much time passed?
4. Now let’s change delta-t in the simulation from 2 seconds to 1 second. Run the simulation again and describe what changed. Pay attention to how many seconds passed before the simulation ended.
5. What would you expect should happen to the amount by which the buggy’s position changes () between each metronome tick when the time between each tick () is changed from 2 seconds to 1 second?
6. Change the body of your next-x function so that the simulation ends in the same amount of time as it did when delta-t was 2 seconds. Write your new next-x function below:

**fun** next-x(x):

**end**

1. Write out the body of your next-x function for different values of delta-t. Test each one in your simulation.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| delta-t | 4 | 2 | 1 | 0.5 |
| **fun** next-x(x): | x + \_\_\_\_ | x + \_\_\_\_ | x + \_\_\_\_ | x + \_\_\_\_ |

1. Is there some relationship between and ? How can you get from delta-t to delta-x?

|  |  |  |  |
| --- | --- | --- | --- |
| delta-t | ??? | **is** |  |
| 4 |  | **is** |  |
| 2 |  | **is** |  |
| 1 |  | **is** |  |
| 0.5 |  | **is** |  |

1. Based on this, write the body of your next-x function so that it will work with **any** value of delta-t without having to change the function.

**fun** next-x(x):

**end**

1. What should be the units of this new term which you added to your next-x function?